V. Pteridophytes (Ferns)

Pteridophytes (Pteros = wings, feathers) are a group of vascular cryptogamic cormophytes. Pteridophytes have a discreet sexuality like all lower plants (no flowers, no seeds, no fruits), they belong, along with algae, fungi, and bryophytes, to the Cryptogams (Kryptos = hidden, Gamos = union). However, pteridophytes form a separate phylum because they possess a vascular system. This is why Pteridophytes are called vascular cryptogams.

Figure : Ferns

They are plants with roots, stems, and leaves, but no flowers. Compared to bryophytes, pteridophytes exhibit a more differentiated vegetative structure, favor the diploid generation over the haploid one.

1- Morphology

a. Sporophyte:

The diploid sporophytic generation is predominant in pteridophytes. This results in a vegetative system equipped with functionally and structurally differentiated organs and tissues.

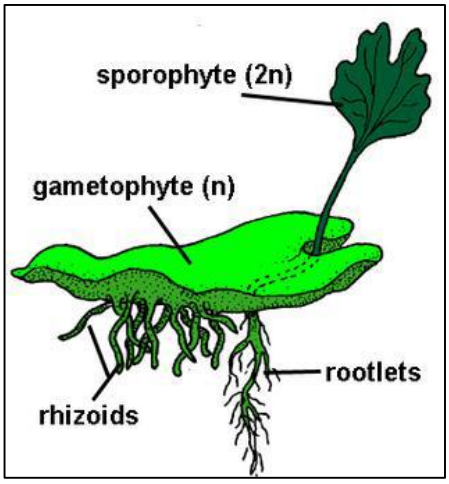

Figure : Sporophyte and gametophyte

• Roots:

The root system appears with the pteridophytes, thanks to the presence of vascular tissues. It provides better anchorage to the soil, but most importantly, it allows the plant to absorb water and mineral salts from deeper layers. Additionally, it provides relative resistance to cold temperatures.

• Vascular Tissues:

Two main types of vascular tissue are present: xylem and phloem.

- **Xylem**: Xylem appears as a rigid tube through which the raw sap moves. It contains typical lignified elements called tracheids; a series of dead, lignified, empty cells that act as capillaries for raw sap conduction. Pteridophytes, because of these vascular tissues, are also called Tracheophytes. These vessels also give plants their upright posture.
- **Phloem**: These are the living vessels made up of living cells, responsible for transporting elaborated sap rich in sugars and other substances produced through photosynthesis in the leaves.

• Leaves or fronds:

With the appearance of stem branching, true leaves emerged. Structurally, a leaf consists of a petiole, a rachis, and a blade divided into pinnae and pinnules.

b. Gametophyte:

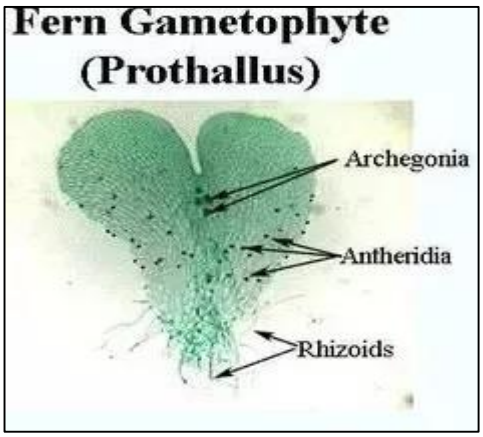

Figure : Prothallus

Pteridophytes are characterized by a very reduced gametophytic generation (a thalloid organization, which is why the gametophyte of pteridophytes is called a prothallus).

These prothalli look like heart-shaped green sheets just a few millimeters long in ferns, or as tiny tuber-like structures in lycopods. They have rhizoids, but lack true organs (no leaves, stems, or roots) and have no vascular tissues. The prothallus bears the sexual reproductive organs known as gametangia.

2- Physiology:

Pteridophytes are chlorophyllous, autotrophic plants that absorb water and mineral salts from the soil and produce organic matter through photosynthesis.

3- Reproduction:

Figure : Sporangia

a. Reproductive organs:

Sporangia: Sporangia develop on the leaves of the sporophyte. In ferns, they are grouped into sori on the underside of the fronds, while in horsetails (*Equisetum*) and *Selaginella*, they are located at the axil of microphylls, themselves grouped into strobili (cones) at the tips of the stems. Sori are often protected by a very thin membrane called an indusium (although some species lack this structure).

Gametangia: Gametangia develop on the underside of the prothallus in ferns and on the projecting part of the prothallus in *Selaginella*. The antheridia, which produce multiflagellated antherozoids, are highly reduced and appear as tiny spheres with a single layer of cells forming their wall. The archegonia, whose general structure resembles that of bryophytes (but smaller), consist of a short neck and a venter embedded within the tissues of the prothallus, where the oosphere (egg cell) develops.

Asexual reproduction:

It occurs mainly through fragmentation of the indefinitely growing rhizome. Some species reproduce exclusively by this method (e.g., *Pteridium aquilinum* or bracken fern).

Sexual reproduction:

Fertilization in pteridophytes is oogamous, and plants can be monoecious or dioecious, depending on the species.

The antheridia and archegonia reach maturity at different times to promote cross-fertilization. Male gametes (*antherozoids*) swim through external water and are chemically attracted to the archegonia, where they fertilize the oosphere (egg cell).

The zygote develops within the archegonium into a young sporophyte, which at first lives as a parasite on the gametophyte, before the latter degenerates and disappears.

There are two main scenarios:

- In isospory, spores are all the same size, leading to isoprothallism, where all gametophytes are identical and monoecious.
- In heterospory, leading to heteroprothallism, there are dioecious plants:
    - Small spores give rise to male gametophytes (small prothalli)
    - Large spores produce female gametophytes (larger prothalli)

The life cycle of pteridophytes is typically digenetic and diplohaplontic, with a strong dominance of the sporophytic generation over the gametophytic generation.

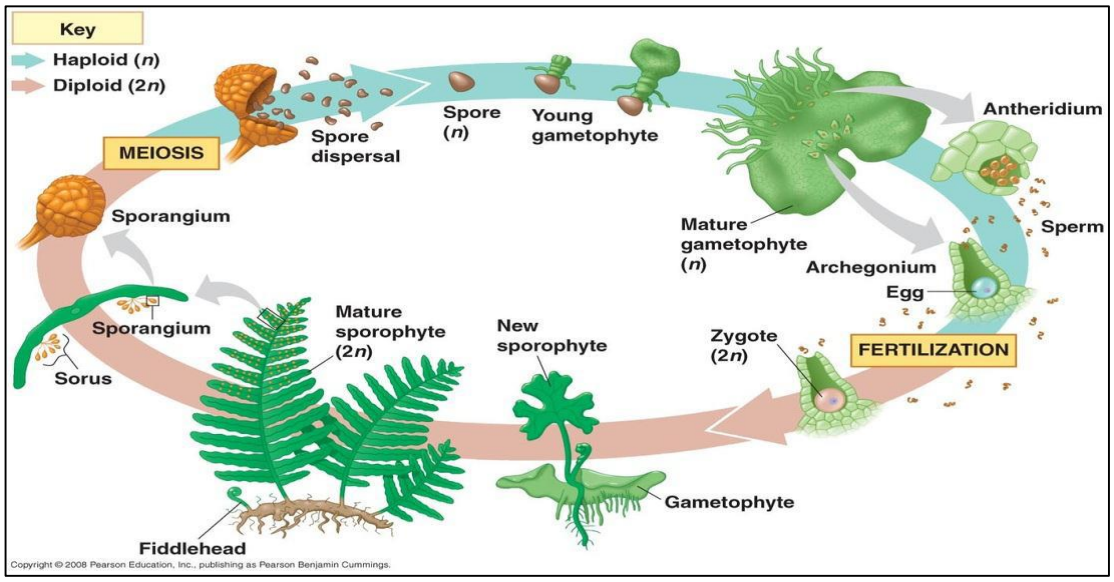

Figure : Ferns life cycle

4- Classification

Pteridophytes are divided into four (4) classes:

4.1 Class: Psilotopsida (or Psilophytes)

Mainly represented by the genus *Psilotum*. These are herbaceous plants lacking true roots and leaves but possessing differentiated woody structures. This class includes three orders: Psilotales, Rhyniales, Psilophytales.

4.2 Class: Lycopodiopsida (or Lycophytes)

Includes around 850 species. They have small, scale-like leaves. Although they do not possess true roots. This class includes three orders: Lycopodiales, Selaginellales, Lepidodendrales

4.3 Class: Equisetopsida (or Sphenophytes)

The surviving species (about 30) belong to the genus *Equisetum*, commonly known as horsetails, which are woody herbaceous plants. Out of 07 orders, 06 are extinct, leaving only:

Order: Equisetales, with a single genus: Equisetum

4.4 Class: Filicopsida (or Filicophytes)

These are the most common seedless vascular plants in the modern flora. It is the largest class of pteridophytes, with around 12000 living species.
Most are herbaceous and are characterized by their large leaves (fronds).

This class includes eleven orders, of which 05 are fossil groups:

Fossil (extinct) orders	***Living orders***
1. Iridopteridales	**1. Salviniales** – aquatic ferns (*Salvinia*, *Azolla*)
2. Stauropteridales	**2. Hymenophyllales** – filmy ferns, delicate and moisture-loving
3. Cladoxylales	**3. Gleicheniales** – small tropical ferns
4. Zygopteridales	**4.Schizaeales** – climbing or creeping ferns
5. Inversicatenales	**5. Osmundales** – includes *Osmunda* (royal ferns)
	6. Polypodiales – largest and most diverse order of modern ferns (includes *Pteris*, *Adiantum*, *Dryopteris*, etc.)

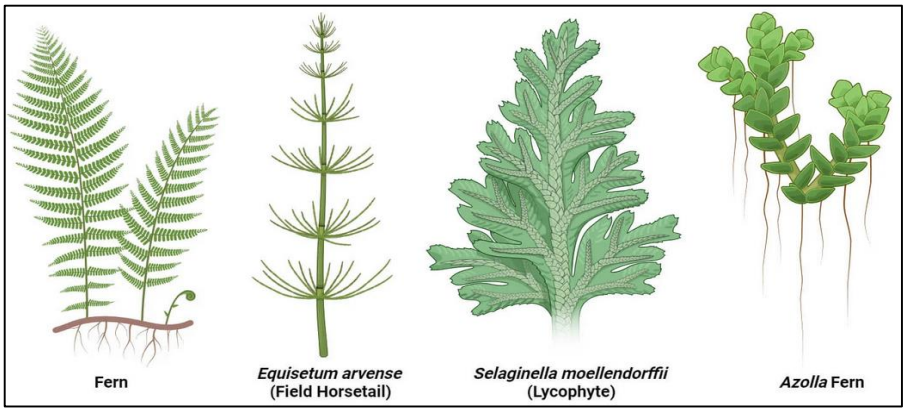

Figure : Pteridophytes species